

forming a discharge port on the discharge port plate by irradiating plural high energy ultraviolet beams simultaneously through the mask plate so that the beams are inclined with respect to a vertical axis that is perpendicular to the mask plate, wherein the formed discharge port has a shape that widens in a direction away from a source of the beams.

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REMARKS

This application has been reviewed in light of the Office Action dated May 9, 2001. Claims 1-3 and 5-15 are presented for examination. Claims 4 and 16-31 have been canceled, without prejudice or disclaimer of the subject matter presented therein. Claims 1 and 6 are in independent form and have been amended to define more clearly what Applicants regard as their invention. Favorable reconsideration is requested.

Claims 1-3, 6-10 and 15 have been rejected under 35 U.S.C. § 102(b) over U.S. Patent 5,263,250 (*Nishiwaki et al.*). Claims 5, 11 and 12 have been rejected under 35 U.S.C. § 103(a) over *Nishiwaki*. Claims 13 and 14 have been rejected under Section 103(a) over *Nishiwaki* in view of U.S. Patent 5,548,894 (*Muto*). Applicants respectfully traverse these rejections.

Independent Claim 1 is directed to a method for processing an ink discharge port of an ink jet head provided with discharge ports for discharging ink, the discharge ports being provided on a discharge port plate. The method comprises the steps of closely contacting a mask plate having openings corresponding to the discharge ports with a face of the discharge port plate on an ink discharge side, and forming the discharge port on the discharge port plate by irradiating plural high energy ultraviolet beams simultaneously

through the mask plate so that the beams are inclined with respect to a vertical axis that is perpendicular to the mask plate. According to the method, the formed discharge port has a shape that widens in a direction away from a source of the beams. Independent Claim 6 is directed to a method for manufacturing an ink jet head and has features similar to those of Claim 1.

By virtue of the method of Claim 1, a discharge port having a tapered shape is formed from an ink discharge side of a discharge port plate. This results in enhanced discharge efficiency and stabilized discharge performance, and it eliminates the need for forming a discharge port plate separately from the ink jet head main body.

Nishiwaki relates to a method of manufacturing a nozzle plate for an ink jet printer, wherein a laser beam is divided into a plurality of beams, the beams are applied to lens elements which further divide the beams into secondary beams, and the secondary beams are used to irradiate openings on a diaphragm in order to form holes in a plate.

Applicants submit that *Nishiwaki* does not teach or suggest to one of ordinary skill in the art all of the elements recited in Claim 1 or Claim 6.

First, Applicants submit that nothing in *Nishiwaki* teaches or suggests the feature whereby a formed discharge port has a shape that widens in a direction away from a source of the beams. The discharge port recited in Claims 1 and 6 has, after formation, a shape that widens going in a direction from the ink discharge side (i.e. the outer side of the discharge port plate, where the laser beam is incident) to the ink jet head main body side (the inner side, from which the laser beam would emanate). This is illustrated, for

example, in Figs. 1B and 5.¹ In Fig. 1B, the discharge port 21, shown in dotted lines, is wider on the right side of the page, adjacent the ink jet head main body 3, and is narrower on the left side of the page, adjacent the mask plate 1. In contrast, nothing in *Nishiwaki* shows or mentions a discharge port having such a shape.

Applicants wish to clarify the above feature in light of the Examiner's response to Applicants' arguments in the last Office Action (paragraph 7). The Office Action stated, in reference to the "wherein ..." clauses in Claims 1 and 6, that "these recitations are very broad and relative terms". Then, in reference to *Nishiwaki*, the Office Action reasoned that "[t]he removal of nozzle plate material would start on one side of the nozzle plate where the laser would initially contact the plate" and "would end when the laser reaches the other side of the nozzle plate such that a hole is formed to make a discharge port". Finally, the Office Action concluded that in *Nishiwaki* "[t]he direction of ablated material from one side of the nozzle plate to the other side of the nozzle plate is said to form a hole or discharge port what (sic) widens 'in a direction away from the source of the beams'".

Applicants understand the Office Action to be arguing as follows:

- (1) When a laser bores a hole in a material, the formation of the hole, or the removal of material, is begun at the contact surface of the material (i.e., the surface of the material at which the laser beam contacts the material), and the hole is formed or grows, or the material continues to be removed, in the direction away from the contact surface, as the laser beam penetrates through the material.

¹The details of the Figures are of course not to be taken as limiting Applicants' claims.

(2) Therefore, the hole is formed or grows in a direction away from the contact surface, and in this sense, the hole 'widens' in a direction away from the contact surface.

In short, Applicants understand that when the Office Action states that the hole "widens" in a direction away from the source of the beams, the Office Action is in fact referring merely to the ordinary process of the formation or growth of the hole which occurs as the laser penetrates through the material. Put otherwise, the Office Action appears to be making the point that when a force is applied to a top surface of a material to bore a hole in the material, in the ordinary course of events the hole begins to be formed at the top surface where the force is applied and proceeds to be formed or grown toward the bottom surface, rather than starting to be formed at the bottom surface which is not in contact with the force and proceeding toward the top surface.

This ordinary process of hole formation, however, is not what Applicants intended to claim in the wherein clauses of Claims 1 and 6 in the last Amendment.

Therefore, Applicants have amended these wherein clauses so as to clarify what Applicants are claiming. Applicants note that Claims 1 and 6 have been amended to reflect more clearly that the wherein clauses refer to the shape of the discharge port after it is formed. Applicants understand the Office Action's response to Applicants' arguments to have focused on the process of formation of the discharge port rather than the shape of the formed discharge port.

Second, Applicants submit that nothing in *Nishiwaki* teaches or suggests the step of Claims 1 and 6 of closely contacting a mask plate having openings corresponding to the discharge ports with a face of the discharge port plate on an ink discharge side.

Applicants note that the Office Action (paragraph 4) states, in respect of this step, that *Nishiwaki* mentions "closely contacting a mask plate 8 having at least one opening 8a corresponding to at least one discharge port (nozzles) of a discharge port plate (nozzle plate) of an ink jet head". The Office Action does not indicate to what *Nishiwaki*'s mask plate 8 is closely contacted. More specifically, the Office Action does not state that *Nishiwaki* mentions the feature of this step whereby the mask plate is contacted with a face of the discharge port plate on the ink discharge side. Indeed, Applicants submit that nothing in *Nishiwaki* would teach or suggest that the mask plate is contacted with a face of the discharge port plate on the ink discharge side. Fig. 3 of *Nishiwaki* shows a mask 8 a distance away from a member 12 to be processed. But Applicants submit that nothing in *Nishiwaki* would teach or suggest that, even if the member 12 were a discharge port plate and the mask 8 were in contact with the member 12, the mask would be on the ink discharge side of the member.

For at least the foregoing reasons, Applicants submit that Claims 1 and 6 are allowable over *Nishiwaki*.

A review of the other art of record, including *Muto*, has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as a reference against the independent claims herein. These claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from Claim 1 or 6 discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however,

the individual reconsideration of the patentability of each on its own merits is respectfully requested.

This Amendment After Final Action is believed clearly to place this application in condition for allowance and its entry is therefore believed proper under 37 C.F.R. § 1.116. In any event, however, entry of this Amendment After Final Action is respectfully requested. Should the Examiner believe that issues remain outstanding, he is respectfully requested to contact Applicants' undersigned attorney in an effort to resolve such issues and advance the case to issue.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,


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Application No. 09/339,869
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VERSION WITH MARKINGS TO SHOW CHANGES MADE TO CLAIMS

1. (Twice Amended) A method for processing an ink discharge port of an ink jet head provided with discharge ports for discharging ink, the discharge ports being provided on a discharge port plate, the method comprising the steps of:

closely contacting a mask plate having openings corresponding to the discharge ports with a face of the discharge port plate on an ink discharge side; and

forming the discharge port on the discharge port plate by irradiating plural high energy ultraviolet beams simultaneously through the mask plate so that the beams are inclined with respect to a vertical axis that is perpendicular to the mask plate,

wherein the formed discharge port [is formed to widen] has a shape that widens in a direction away from a source of the beams.

6. (Twice Amended) A method for manufacturing an ink jet head provided with discharge ports for discharging ink and a discharge port plate having the discharge ports, the method comprising the steps of:

closely contacting a mask plate having openings corresponding to the discharge ports with a face of the discharge port plate on an ink discharge side; and

forming a discharge port on the discharge port plate by irradiating plural high energy ultraviolet beams simultaneously through the mask plate so that the beams are inclined with respect to a vertical axis that is perpendicular to the mask plate,

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